



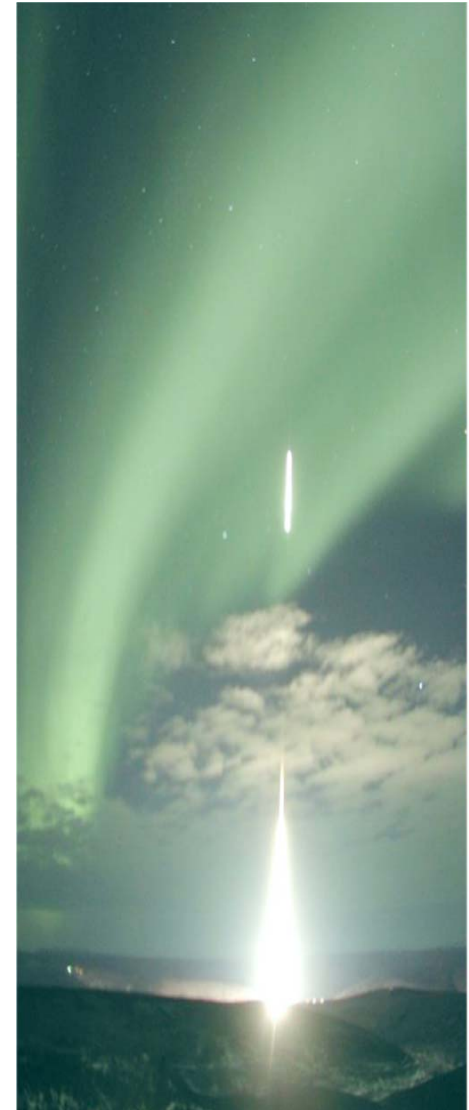
5/3/2004



## NASA SOUNDING ROCKETS PROGRAM



GSFC-WFF





## The Mission of the Sounding Rocket Program

- Provide quick response, cost effective suborbital access to the upper atmosphere and near-Earth space environment (90km – 1500km)
- Conduct suborbital flight operations from fixed and mobile locations around the world. We go where the science is...



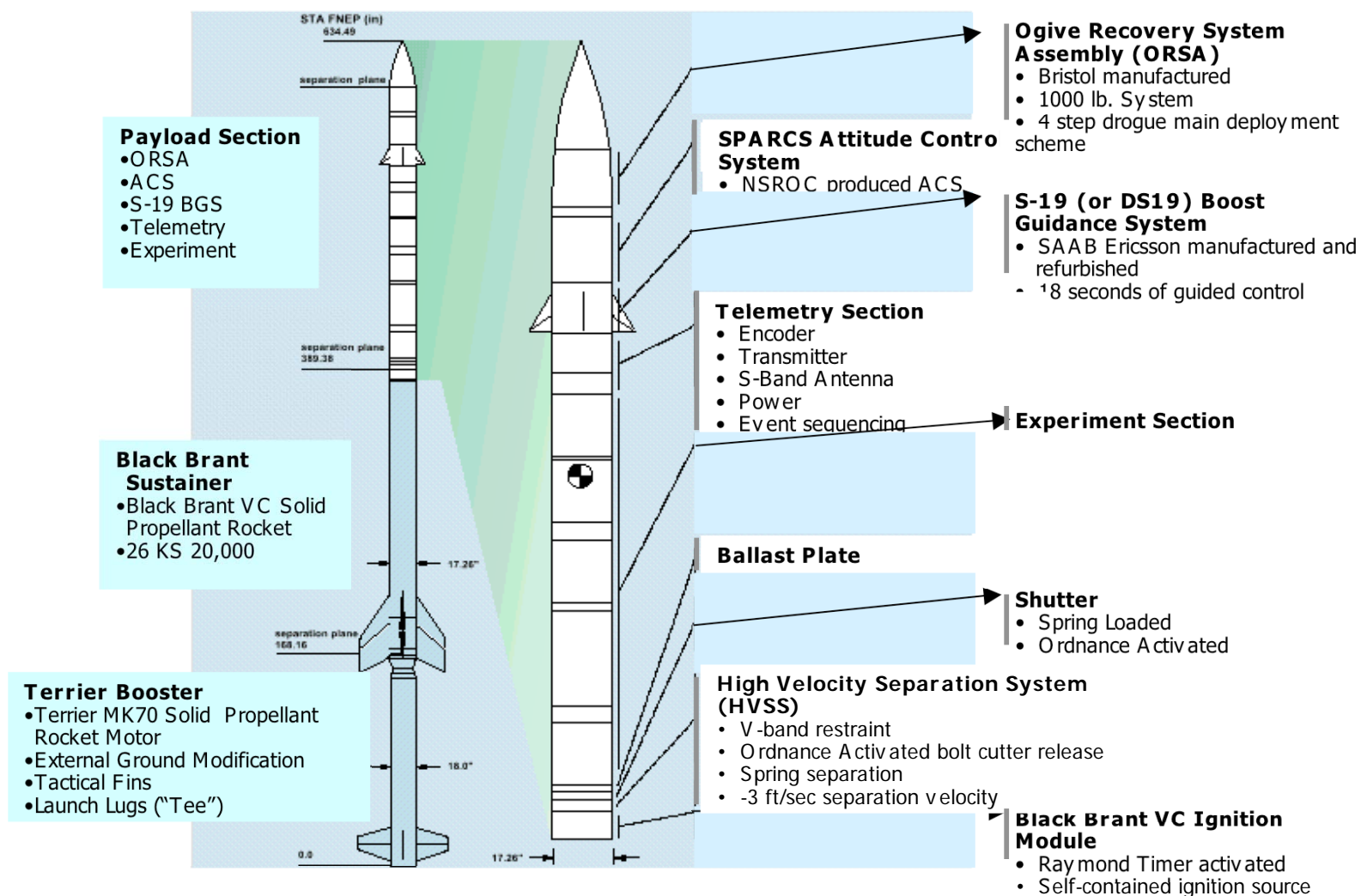


## Benefits of Sounding Rockets

- >350 PhDs have been based on data obtained using NASA sounding rockets
- Sounding rockets enable new space-based sensor technologies to be demonstrated in a space environment before they are used on satellites
- Sounding rockets enable in-situ measurements in regions not accessible by balloons or satellites (fill a unique niche)
- Sounding rockets serve as valuable tools for validating and calibrating remote sensors on operational satellites (under-flight missions)
- Mobile capability allows missions to be flown where the science occurs (magnetic equator, auroral zone, southern sky, etc)
- Sounding rocket performance can be “selected” to best fit the experiment requirements (provides for efficiency)
- Quick response (prime example - Super Nova 1987A)



# Representative Sounding Rocket System







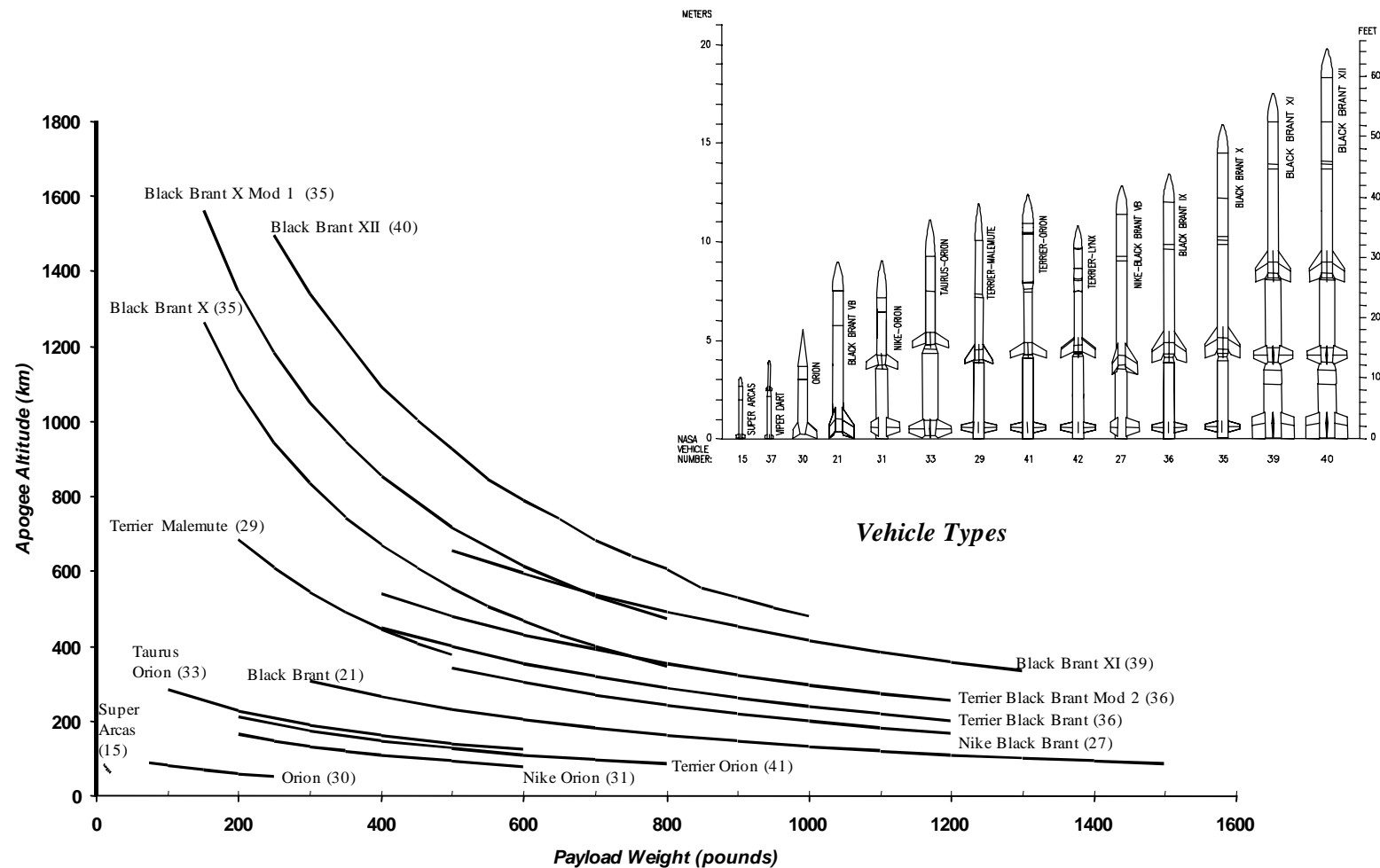
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# Sounding Rocket Launch Vehicles





# Sounding Rocket Vehicles



*Terrier Malemute*

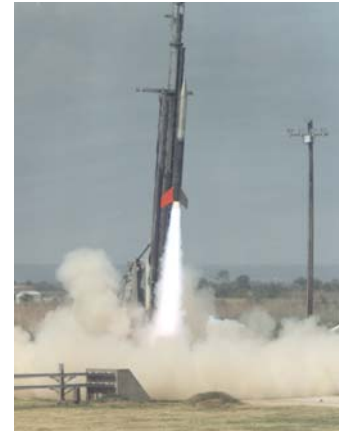


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*Terrier Orion*

*Black Brant XII*



*Orion*



*Black Brant IX*



# Mission Overview - Sample

PI: Dr. Paul M. Kintner, Cornell University

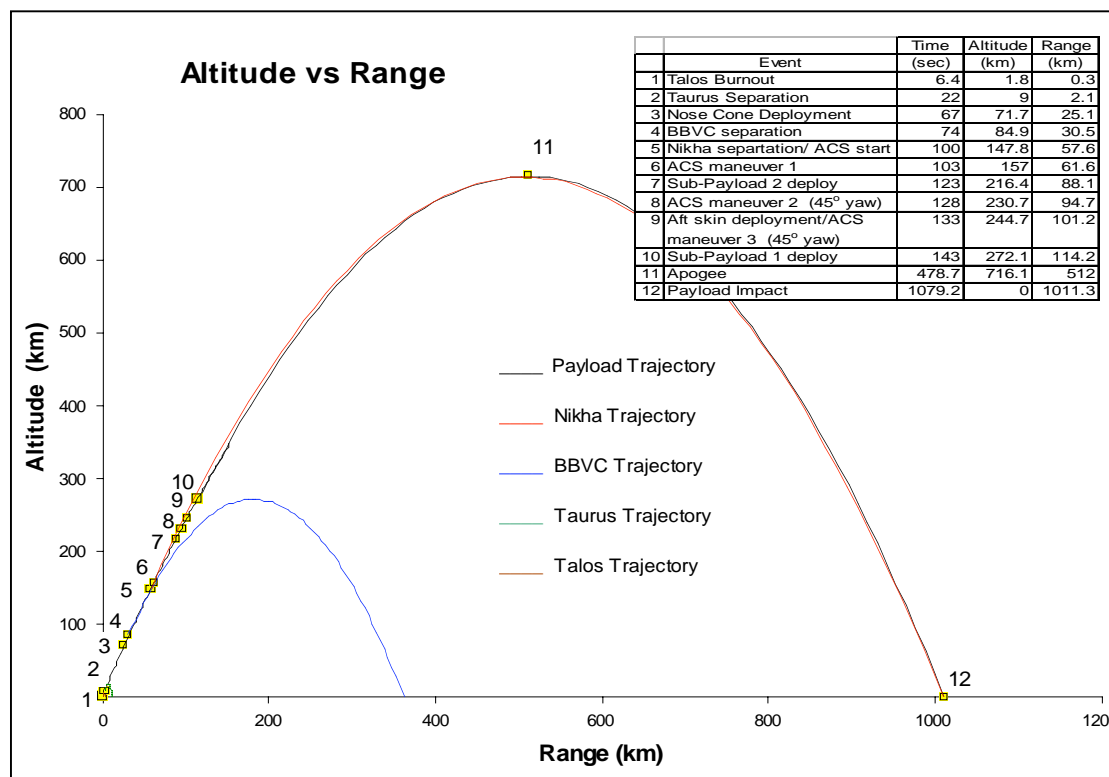
Scientific Objective: To investigate the primary causes of Transverse Ion Acceleration (TIA) in the topside auroral ionosphere in order to resolve basic conflicts in the theory of TIA, in models of current-driven instabilities, and in observations of TIA.

Technical Objective: To prove the feasibility of yo-yo booms damper system and combined GPS/ S-Band antenna.

Launch Date: 1/24/02

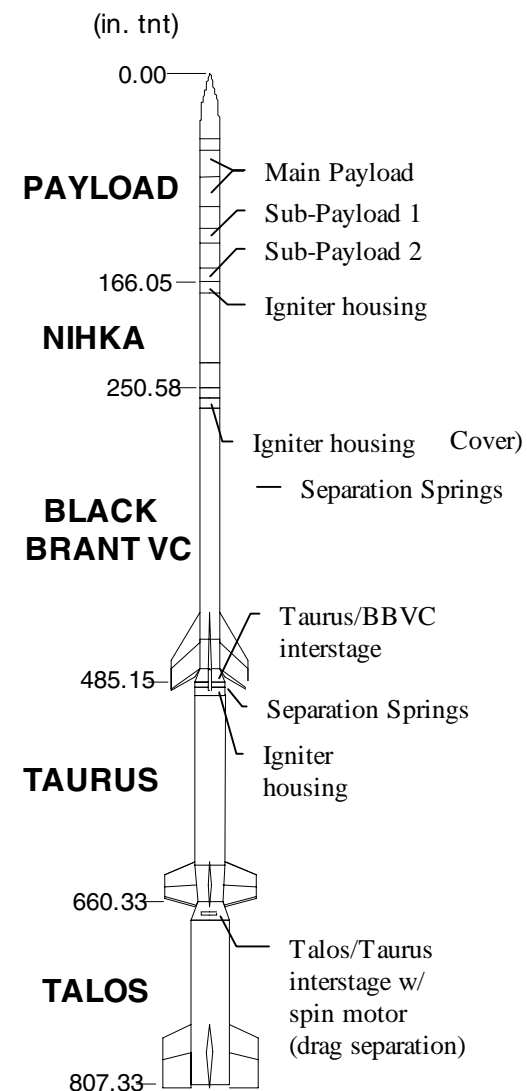
Launch Range: Poker Flats Research Range, Fairbanks, Alaska

Launch Vehicle: Black Brant XII



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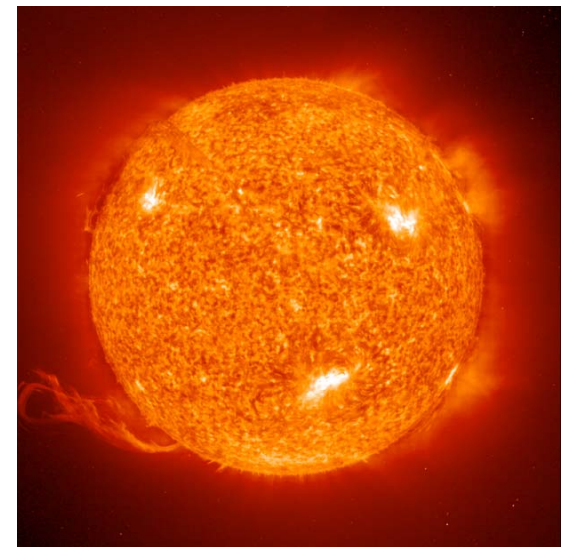






## Scientific/Engineering Disciplines Supported by the NASA Sounding Rocket Program

- Geospace Sciences
- Solar Physics
- High Energy Astrophysics
- UV/Optical Astrophysics
- Microgravity
- Hypersonics





## Organizations Supported by the NASA Sounding Rocket Program

- Universities
- NASA Centers
- Research Institutes
- Department of Defense

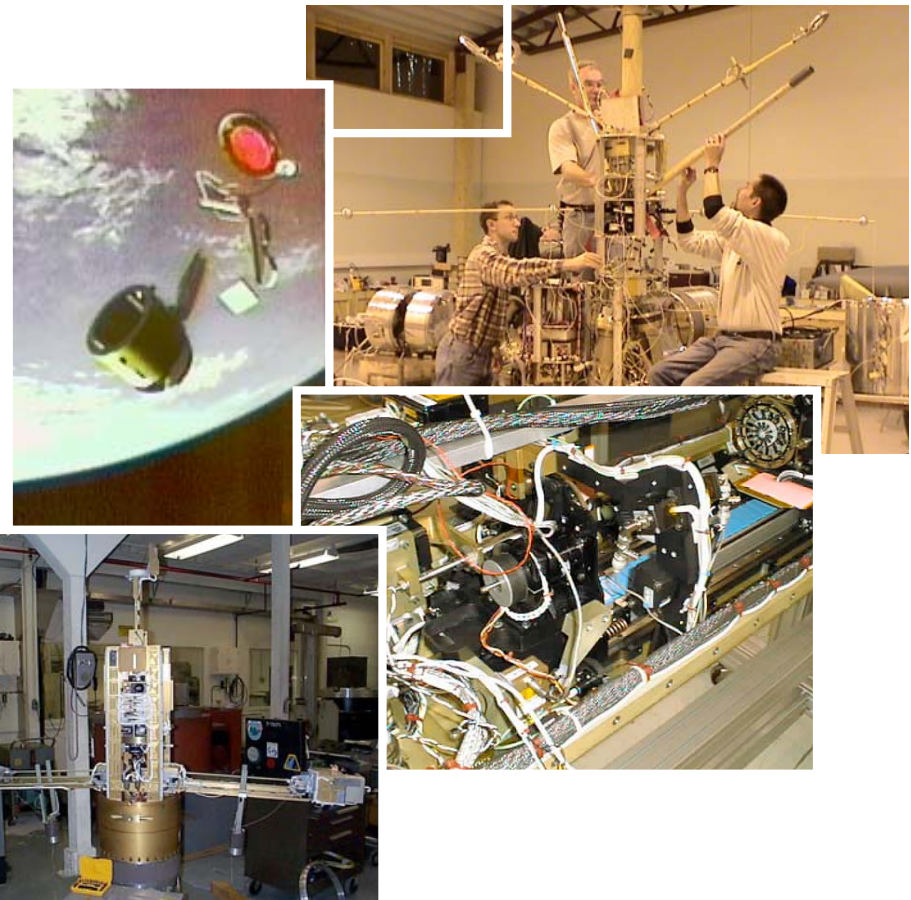




# Experiments

- Astronomy (UV, X-ray, Gamma-ray, Visible, etc)
  - Spectroscopy
  - Polarimetry
- Plasma Physics (Geospace sciences)
  - Particle Detectors
  - E-field Booms
  - Magnetometers
- Microgravity
- **Air Sampling**
- Atmospheric Entry Vehicles

Many payloads include multiple sub-payloads and 2 or more high rate telemetry links





## Launch Sites

- US Fixed
  - Wallops Flight Facility
  - White Sands Missile Range
  - Poker Flat Research Range
  - Kwajalein
- Foreign Fixed
  - Sweden
  - Norway (Andoya & Svalbard)
- Mobile
  - Australia
  - Brazil
  - Kwajalein
  - Puerto Rico
  - Greenland
  - Peru



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## Flight Durations

- Typical data periods only 5 to 20 minutes in length
- High altitude parachutes can be used to lengthen data collection periods to 60 min. or more
- Small rockets can be used to conduct temporal experiments enabling discrete measurements over days, weeks or even months







## Potential Applications

- Collection of scientific data
  - Air sampler missions
  - Thunderstorm research
  - Other?
- Space-based instrument development
  - Limited exposure time
  - Enables system adjustments prior to incorporation into more expensive satellite mission
- Satellite calibration
  - Mobile operations can enable data collecting in regions of interest (polar, equatorial, etc.)



# Enabling Technologies



## Small, Low-cost Vehicle

- 4.5” diameter dart (non propulsive)
- 90-110 km apogee
- Low-cost telemetry
- Potential for ejectable payload with high altitude parachute
- Mission could include multiple flights over period of time



MLRS-Dart Vehicle



## SubTec Technology Demonstration Payload

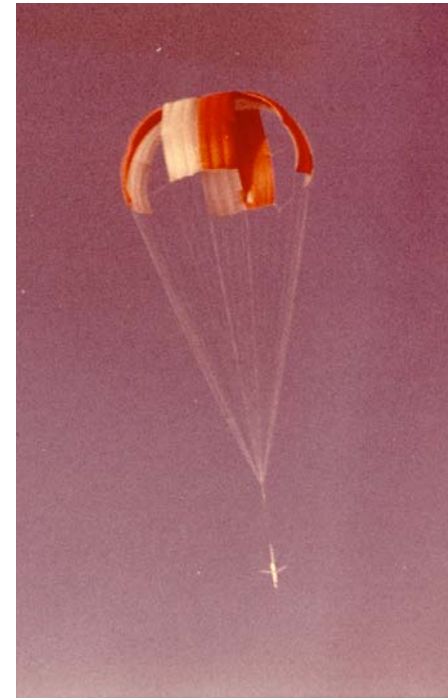
- Developed to provide low-cost technology test flight opportunities
- Ride share concept
- Defined experiment volume
  - Greatly reduces mission cost (minimal design)
- Reusable payload
- Water recovery off Wallops
- Could be flown at WSMR (New Mexico) or Poker Flat Research Range (Alaska)
- One or more flights per year depending on demand





## High Altitude Parachutes

- Deployed at ~100 km altitude
- Slows the descent of the payload so fine resolution measurements can be made
- Keeps payload in “end down” orientation
- 72’ diameter
- Nylon or Mylar construction
- Not a “new” technology







## Telemetry

- Data rates currently at 10 Mb/s, with a development effort to move towards 150 Mb/s
- Video compression and wide-band transmitters to support image downlink
- Small, compact telemetry systems to fit in small packages



## Mobile Range Capabilities

- Range control, radar, TM, and launchers
- Shifting to GPS tracking
  - Will reduce operations cost

